complicated as possible. Also prepare a few slides. They may be shown at embarrassing moments.

As soon as the club is assembled, gaze upon them with a dreamy eye and begin your talk.

The first step is to write nine long equations on the board.

Somebody will call your attention to the fact that the fifth term of the first equation should have a minus sign.

Memorize the equations beforehand if possible. Write them rapidly.

The success of your talk will depend directly on the number of people you can shake off at this point.

Mathematics is always helpful in this way. If your audience looks too intelligent, cover the board with partial derivatives and integral signs.

Having presented the equations dwell at great length on the sub-electron, the rigidity of the ether, or the density of petrified rhubarb in Siberia.

Finally when you see that vacant stare, indicative of a temporary lapse of intelligence, steal into the eyes of the front row, it is time to stop.

Pause for effect. Gather up your books—several volumes of "Annalen der Physik" and four score and seven sheets of loose notebook paper and ask for questions.

There will always be questions. They are indicative of an intelligent audience.

Then there will be a discussion. In this *you* will have no part. However, at its close you will be convinced of three things:

First: that you were entirely wrong.

Second: that you did a fine piece of work.

Third: that it doesn't mean anything.

The moral of this paper is: It is much easier to take data than to interpret the results.

A. W. SIMON

SCIENTIFIC BOOKS

Organic Dependence and Disease: their Origin and Significance. By JOHN M. CLARKE. Yale University Press, 1921. Pp. 113, 105 text figs.

In a new book, marked by deep thinking, and written with Huxleian vigor and picturesqueness of phrase, we have presented to us the philosophy of righteous living as seen by a paleontologist, a life-long student of Paleozoic faunas and floras. Beginning with a study of mutual and commensal living, we are shown how this develops into parasitism, and out of it all comes to us the true significance of ease in life and dependence. Progress, racial or individual, does not lie in this direction, and once entered upon, there is no return road to independence, the only righteous mode of living.

We need not present the evidence on which Clarke's philosophy is based, since the book itself gives this so clearly, but can go at once to the conclusions. Parenthetically, however, we would advise the reader to study along with the book under review Conklin's "The Direction of Human Evolution," a most interesting work on philosophical naturalism, showing what evolution has done for man morphologically, and what in all probability social evolution will do for him. In these two books we have revealed to us the naturalist's religion as Nature has unfolded it throughout the geological ages. As Conklin says,

> The new wine of science is fermenting powerfully in the old bottles of theology.

The purpose of Clarke's essay is to set forth the apparent controls governing the historical origin of dependent and abnormal conditions of life, and from this evidence to generalize their significance to humanity. The bases of this knowledge are Paleozoic invertebrate fossils, plus the vista of organic accomplishments through untold millions of years. The evidence is presented without embarrassing detail and the conclusions without bias, and their human concerns are of high moment.

The author states that "disease is discomfort," and agrees with Huxley that "disease . . . is a perturbation of the normal activities of a living body." In other words,

Disease is *any departure from normal living*. . . . The *entire body*, organism or creature and the *entire race* or stock to which it belongs may become abnormal through subjection to an abnormal or perturbed mode of life. Such body, creature, race or stock is therefore in a state of disease.

The question, What is normal living? is answered through a study of the earliest marine faunas.

Normal living, in the broad sense in which we desire to be understood, means full activity of an unimpaired physiology inclusive of the function of locomotion or mobility. . . . Independent living, freedom of locomotion and range expose the individual to ever new dangers. These the individual must quickly overcome or outwit; otherwise succumb. The choice is quick, imperious and final. . . . Normal living is, in terms of biology, correct living, that is to say, righteous living, and in so far as dependence invades the mode of life whether in organ or individual, such living is unrighteous, disordered and diseased; in better phrase, biologically, is without hope, for such perturbation or disease is beyond voluntary or casual rectification.

Out of right or normal independent living have come all the great triumphs of life; the races of life which, by keeping individual and racial independence, have persistently climbed upward. . . . The giants of the redwood forests are the hoary and venerable obelisks of power shackled beyond redemption; the gardens of flowers are blossoms of a hope never to be attained.

In all of the evolution of endlessly variant life, there has been, however, "a strong minimum, a redeeming minority, of competent upward evolution." It is a certainty that the minorities of geologic life have saved the day for us.

Wise students of nature, in reflecting on this thought, have broken out into exclamations of wonder and amazement at the slender thread of chance by which we who call ourselves men have come to this estate, in a world where for millions of years the temptation to the easier way and the obstacles to independent living were constantly against us.

It would be trite to say that a perfectly adjusted life is an unprogressive one. The adjusted life makes for conservatism and reduces the chances of variation to its lowest terms. . . . Speaking for the moment in higher terms for the individual the adjusted life is likely to carry with it the highest content of happiness. To progress in organic development it is the undeniable foe, but to the conservatism of intellectual and spiritual ideals the undoubted friend.

Clarke finds that 90 per cent. of Cambrian organisms led a life of independence. In subsequent time, dependent life becomes ever greater in individuals and races. Interdependent individual life as expressed in mutual and commensal adaptations is sparingly present in the Ordovician but "not until life had got in full swing did these organic combinations come into existence, even in their simplest commensal expressions." Out of the innocent combination of symbiosis arises parasitism, "an adaptation in which one organism has become helplessly dependent on another for its existence."

If dependence has affected and sealed the fate of one great division of the Kingdom of Life, so that it is and must remain subsidiary to the larger purposes of nature, dependence also has entered upon, invaded and degenerated a very large part, indeed, probably the major part of the other, the animal world. . . . Dependent races of animals have sought or accepted dependence as an easier mode of living, either waiting upon the unconscious forces of Nature, waves and winds, or on the normal activities of other animals. Such dependence has entered in some degree upon all primitive stocks of animal life and from such racial dependence there has been no escape. The lines in the animal world along which links in the chain of advancement have continued unbroken, are but few; the rest have run out into culs-de-sac where all hope is abandoned.

Rescue of dependents is therefore not a part of the scheme of Nature, except through the exercise of intelligence. In Nature's plan of evolution dependents of all sorts are negligible and abandoned to hopelessness, save as gradually developing psychic factors intervene.

These conclusions are so well established that we may rightly look to them for light upon the interpretation of certain tendencies to rest and unrest, conservatism and impulsive change, in human society, and while it may not seem very appropriate to speculate on the further bearing of this theme, it must be said in looking back over the field of organic history, that the value of the product must be in terms of the worth of the type

conserved or broken; that is, worth in the sense of highest attainment in functional grade and in the approach to mentality.

CHARLES SCHUCHERT

SPECIAL ARTICLES

A SIMPLE MICRO-INJECTION APPARATUS MADE OF STEEL

For injection and suction purposes in the field of the compound microscope two very good methods are in existence. One is Barber's[1] mercury pipette. This consists of a glass tube completely filled with mercury. One end is bent into several loops and sealed at the tip. The other end is drawn out into a capillary with a microscopic aperture at its tip. The pipette is held in Barber's pipette holder which is clamped to the stage of the microscope. For injection and suction purposes Barber depends on the expansion and contraction of the mercury by varying the temperature of the loops of the pipette. This method gives excellent results but the pipette is rather difficult to make, it is easily broken and the driving force of the mercury can not be instantly controlled.

A more recent method is that of Taylor's,[2] which also consists of a mercury-filled pipette, but which depends upon a minute plunger to regulate the pressure of the mercury. The plunger method gives the operator a better control of the pressure in the pipette but has the disadvantage of possible leakage around the plunger. This generally occurs after the plunger has been used several times. A great deal of time tends to be wasted in keeping the apparatus in a working condition.

The apparatus described here is very simple to set up and, excepting for the few inches of capillary pipette which can be inserted into the apparatus within a few minutes, it is permanently ready for use. The apparatus depends upon leverage clamps to regulate the mercury pressure which can be controlled at any instant. Consisting entirely of steel and heavy glass it is practically unbreakable, a consideration of great importance for easy manipulation.

As in Barber's and Taylor's instruments, mercury is used to procure the necessary pressure. The apparatus consists of a thin-walled, (.028 inch or less thick), straight, one half inch, steel tube about six inches long (see figure). Into one end of this is sealed an

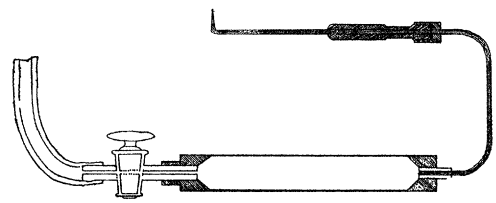

FIG. 1.

accurately fitting steel or glass stopcock. The other end leads into a small steel tube fine enough to be flexible, viz., about 3/32 of an inch in outside diameter. The small tube is bent into a twisted S shape, so that, when at rest, its tip lies on a pipette carrier on the stage of the microscope. The tip of this thin tube is furnished with a screw joint by means of which it may be attached to a hollow steel rod two inches long which carries the glass micro-pipette. The outer end of the stopcock is connected with a rubber tube about four inches long. The steel tube is placed in a special clamping device which is secured to the table beside the microscope. This clamping device consists of three leverage clamps, one of which presses on the steel tube in a direction at right angles to that of the other two.

The apparatus is first filled with clean mercury through a glass funnel inserted into the rubber tube upon which the stopcock is closed. The glass pipette is made according to Barber's method[3] and is sealed with wax into the hollow steel rod.

[1] Barber, M. A., 1911, "A technic for the inoculation of bacteria and other substances into the cavity of the living cell," *Jour. Inf. Dis.*, VIII., 348; 1914, "The pipette method," etc., *The Philip. Jour. Sc.*, Sec. B, Trop. Med., IX., 307.

[2] Taylor, C. V., 1920, "An accurately controllable micropipette," SCIENCE, N. S., LI., 617.

[3] See footnote 2, also Chambers, R., 1918, "The microvivisection method," *Biol. Bull.*, XXXIV., 121.